Hypoxia imaging with FAZA-PET and theoretical considerations with regard to dose painting for individualization of radiotherapy in patients with head and neck cancer.

PURPOSE: To evaluate the role of hypoxia positron emission tomography (PET) using [18F]fluoroazomycin-arabinoside (FAZA) in head and neck cancer for radiation treatment planning using intensity-modulated radiotherapy and dose painting. METHODS AND MATERIALS: Eighteen patients with advanced squamous cell head and neck cancer were included. Both FAZA-PET and axial CT were performed using mask fixation. The data were coregistered using software based on mutual information. Contours of tumor (primary gross tumor volume, GTV/CT-P) and lymph node metastases (GTV/CT-N) were outlined manually, and FAZA standardized uptake values (SUVs) were calculated automatically. The hypoxic subvolume (GTV/PET-FAZA) having at least 50% more FAZA uptake than background (mean SUV) neck muscle tissue was contoured automatically within GTV/CT-P (GTV/PET-FAZA-P) and GTV/CT-N (GTV/PET-FAZA-N). RESULTS: The median GTV/PET-FAZA-P was 4.6 mL, representing 10.8% (range, 0.7-52%) of the GTV/CT-P. The GTV/PET-FAZA-N was 4.1 mL, representing 8.3% (range, 2.2-51.3%) of the GTV/CT-N. It was significantly correlated with the
GTV/PET-N (p = 0.006). The GTV/PET-FAZA-P was located in a single confluent area in 11 of 18 patients (61%) and was diffusely dispersed in the whole GTV/CT-P in 4 of 18 patients (22%), whereas no hypoxic areas were identified in 3 of 18 patients (17%). The GTV/PET-FAZA-N was outlined as a single confluent region in 7 of 18 patients (39%), in multiple diffuse hypoxic regions in 4 of 18 patients (22%), and was not delineated in 7 of 18 patients (39%). CONCLUSION: This study demonstrates that FAZA-PET imaging could be used for a hypoxia-directed intensity-modulated radiotherapy approach in head and neck cancer.